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PROPERTIES OF JOVIAN RADIO BURSTS AT FREQUENCY 20.1 MHZ

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ABSTRACT

In this paper, a study was made to determine the properties of Jovian radio bursts emitted at frequency 20.1MHZ. The data were provided from the Radio Jove archive for twelve years (2000-2012) for multi stations. The duration time for Long bursts (L) was (10-30) seconds and for Short bursts (S) was (10-20) seconds. The effect of radio bursts from the Sun and the galactic background were calculated at the same frequency and were found that radio bursts from the Sun will reduce the occurrence probability of Jovian radio bursts much more than radio bursts from the galactic background. The distribution of Jovian radio bursts was different; the occurrence probability with respect to the northern latitudes was more than the southern latitudes.

KEYWORDS: Radio Bursts, L-Bursts, S-Bursts

INTRODUCTION

The narrow band properties of Jovian radio bursts were discovered by Gallat [1] in observations made from (1956-1957). It was shown that bursts recorded at frequencies spaced by 2MHZ displayed correlation. Warwick [2] described dynamic spectra of Jovian emissions with bandwidths of the order of 600 KHz (the frequency resolution limit of the Boulder spectrograph) and with durations of tens of minutes. Further observations of narrow band emissions have been made by Riihimaa [3-5]. Clavert et al. studied (S-bursts) from Jupiter, which was observed at France and Australia at frequencies from (10-26) MHz [6]. Boudjada et al. [7] analyzed Jovian millisecond radio bursts (S-bursts). Additional studies for (L and S) bursts were made by Arkhypov and Rucker [8-11]. Jovian bursts are so strong that can be picked up using a small antenna and short wave receiver. There are two types of radio noise bursts, long bursts, which sound like ocean waves breaking up on a beach and short bursts, which sound like a handful of pebbles tossed onto a thin roof. Figure (1) and figure (2) explain typical (L and S) burst received at Darjeeling station [12]. The Io-B and Io-C radio noise storms are often very intense and are made up mostly of S-bursts, although it is not uncommon to hear a mix of (L and S) bursts activity Io-A and non-Io activity are mostly L-bursts. Since Io-B emissions are strong and predictable, this is the noise storm type that is easiest for the amateur to monitor successfully [13-15].

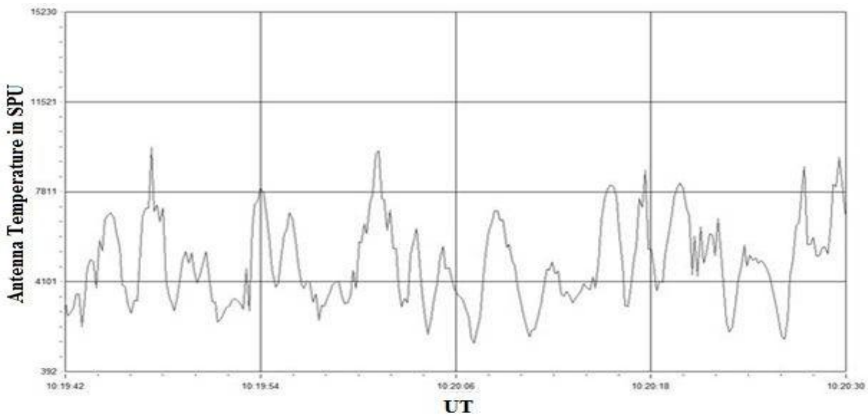


Figure 1: Typical L-Bursts Received at Darjeeling Station [12]

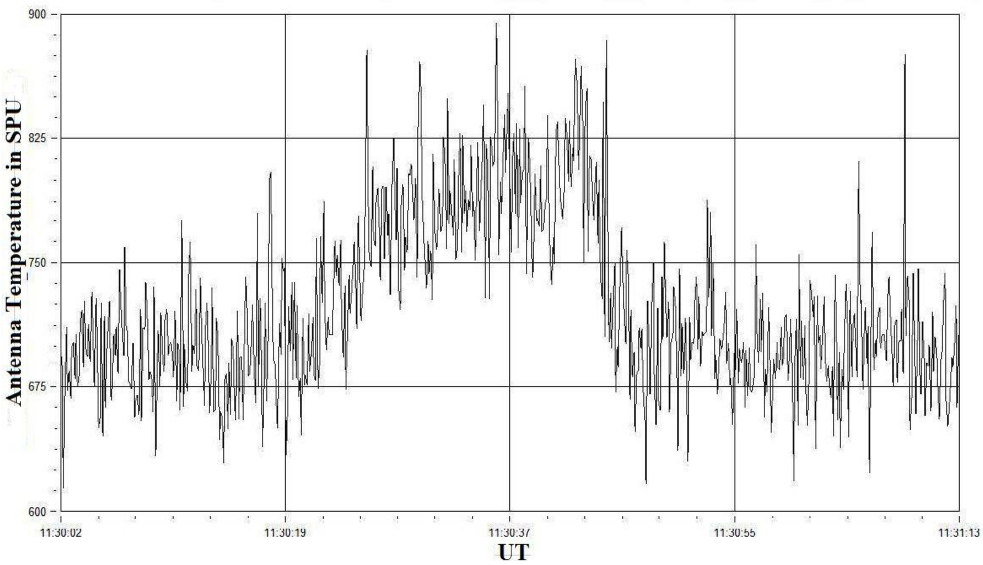


Figure 2: Typical S-Bursts to the Right Received at Darjeeling Station [12]

RADIO JOVE DATA ARCHIVE

This NASA website is used to store the observations that are carried out by astronomical groups using Radio Jove telescope at frequency 20.1MHZ for radio bursts that emitted from Jupiter, Sun, Galactic background and interference. The data archive including all observation information such as observer name, station location (latitude and longitude), observation date, observation time (start and end time), type of object (Sun, Jupiter and Galactic background), observations from 2000 until 2012 can be achieved from the archive, data during twelve years for multi stations were taken. The chosen of multi years and multi stations is to get a high number of observations from radio Jove archive (http: //radiojove.gsfc.NASA.gov.).

RESULTS AND DISCUSSIONS

The duration time of radio bursts that emitted from Jupiter were calculated at specific frequency that is 20.1 MHZ. This radio burst occurs during the occurrence of radio storm, that are related to Io's position (Io-A, B, C, D) and unrelated to Io's position (non-Io-A, B, C, D), which lasts from a few minutes to several hours, while the radio burst lasts from few seconds to several tenths of seconds. In one storm there was a probability for radio bursts to not occur, other storms one type or more than one type can occur. These bursts occur at different frequencies such as (17.8, 19.8, 20.1, 18-28)

MHZ, but a large number of burst occur at 20.1 MHZ. Figure (2) describes the distribution of radio bursts at different frequencies. A large number of these bursts occurred at 20.1MHZ regardless of their type, a small number occurred at 19.7MHZ. The duration time had been calculated at this frequency within twelve years (2000-2012), which is the period required for Jupiter's planet to complete one cycle around the Sun, to get a large number of bursts. The results indicated the time required for L- bursts was (10-30) seconds, while the time required for S-bursts was (10-20) seconds, as shown in figure (4). A large number of bursts occurred (1-10) seconds for both (L and S) bursts. Bhattacharya et al.[15] had calculated the duration time of these bursts and found L-bursts was less than 10 seconds, while S-bursts was less than 1 second, as shown in table (1). The difference between the results of the present duration time from the Radio Jova archive and Bhattacharya et al.[15] calculation was attributed to the duration time of the storm. In addition, the effect of radio bursts that emitted from the Sun and galactic background had been calculated at this frequency, because earlier there were years the observer on the Earth could not detect any radio bursts from Jupiter's

planet. This was due to the effect of radio bursts that emitted from the Sun and galactic background that occur at the same frequency of Jupiter's radio bursts 20.1 MHZ, which reduces the number of radio bursts from Jupiter, as shown in figure (5).

A large number of radio bursts occurred at year 2008, in this year the number of L-bursts was (18) burst. The effect of galactic background is not like the effect of the Sun during their occurrence. The radio bursts from Jupiter is inversely proportional, as:

$$N.O.R.B_{Sun} \propto 1/N.O.R.B_{Jupiter} \quad (1)$$

Where: $N.O.R.B_{Sun}$: is the number of radio bursts from the Sun, $N.O.R.B_{Jupiter}$: is the number of radio bursts from Jupiter. The effect of latitude on detection of these bursts also had been calculated. The results indicated that large number of these bursts occurred at northern latitudes, which showed large number of bursts occur at 40°N, while small number occurred at 60°N. A small number of radio bursts occurred at southern latitudes, as shown in figure (6).

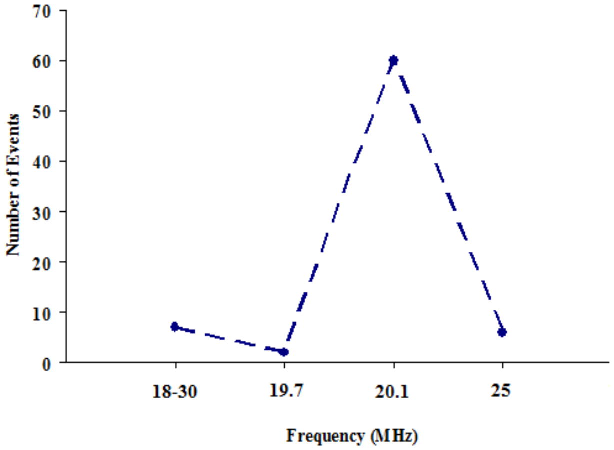
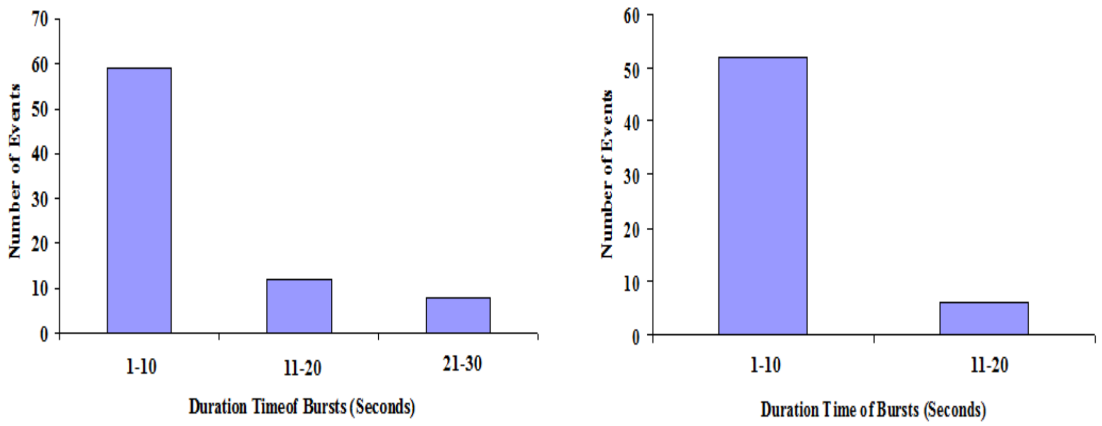


Figure 3: Explains a Large Number of Radio Bursts at 20.1MHZ



(a) (b)

Figure 4: (A). Duration Time of L-Burst, (B). Duration time of S-Burst

Table 1: Types of Radio Bursts

Bursts Designation	Time (Seconds) from Radio Jove Archive	Time (Seconds) [15]
L	10-30	>10
S	10-20	> 1

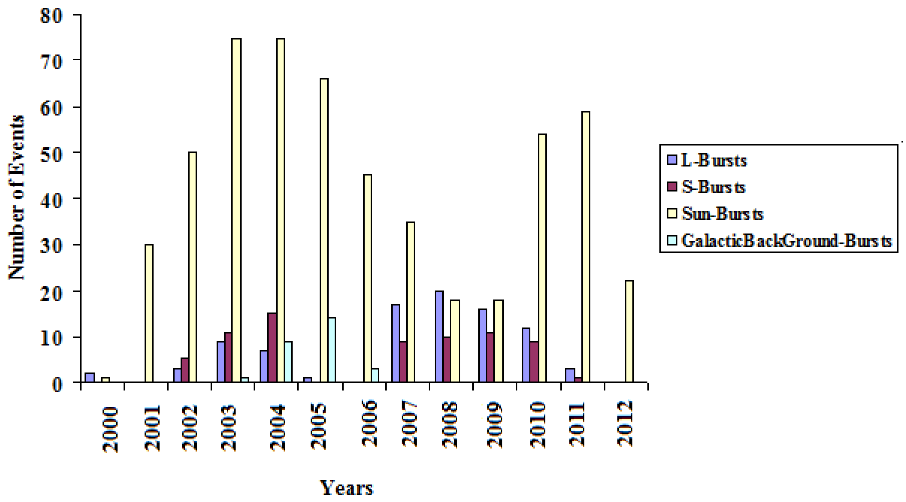


Figure 5: The Effect of Radio Bursts from the Sun and the Galactic Background on Jupiter Radio Bursts

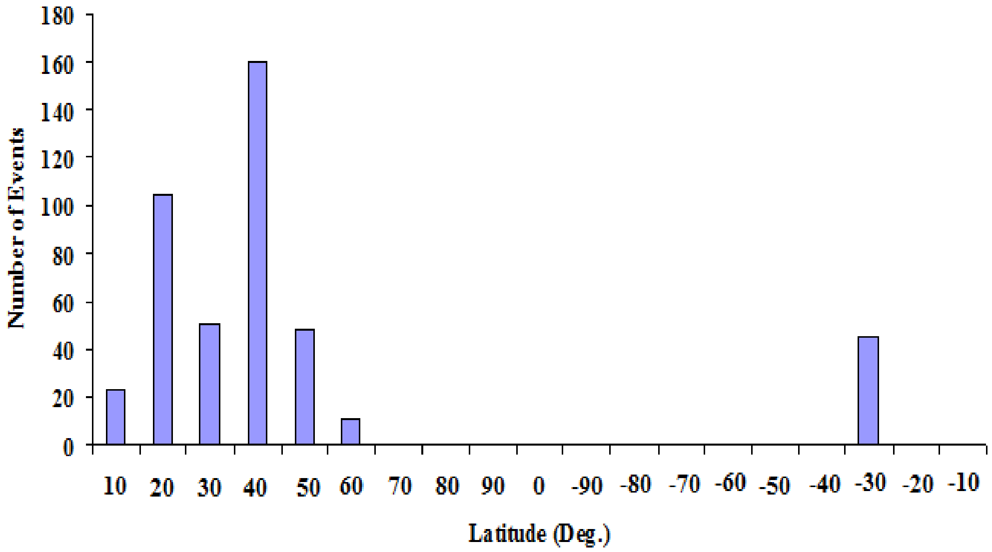


Figure 6: Distribution of Radio Bursts along the Latitudes

CONCLUSIONS

The difference in the duration time between (L and S) bursts referred to receiving L-bursts more than S-bursts. The distributions of (L and S) bursts along the twelve years were random, depending on receiving radio storm emitted from Jupiter. Storm properties depend on two parameters: the longitude of Jupiter and the longitude of Io's satellite. The Sun and the galactic background emit intense radio bursts at the same frequency of Jovian radio bursts, which reduces number of occurrence.

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